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ABSTRACT

This annotated bibliography was developed as a result of a May, 1991, Technology Seminar on Multimedia, and is intended to provide researchers with an overview of the literature pertaining to the development of multimedia technology, innovative applications, design, and implementation issues as well as with descriptions of major multimedia research and development projects and prototypes. References are dated from 1979 to 1991 and are listed alphabetically by author under the following categories: applications (8); applications--language acquisition (2); applications--library (4); applications--robots (1); artificial intelligence, knowledge engineering (9); CD-ROM (2); cognitive science (4); cultural/ethical issues (3); current multimedia projects (5); historical perspective (2); hyperbase (1); hypermedia (16); hypertext (10); instructional design (12); interactive video (3); multimedia (4); overview (8); training (2); videodiscs (6); and virtual reality (1). (DB)

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INTRODUCTION

The Center for Special Education Technology at The Council for Exceptional Children is a national information center funded by the U.S. Department of Education, Office of Special Education Programs. The Center's goals are to influence the quality, availability, and use of technology in special education through information.

In May 1991, the Center convened a group of eminent researchers at a Technology Seminar on Multimedia. The goals of the seminar were: (1) to update researchers on emerging multimedia technologies, (2) to examine potential applications of these technologies for special education students, and (3) to identify research issues and implications for the design and use of these technologies in special education instruction and training.

This document is designed to provide researchers with an overview of the literature pertaining to the development of multimedia technology, innovative applications, design, and implementation issues as well as descriptors of major multimedia research and development projects and prototypes.

Ashworth, D., & Stelovsky, J. (1989). Kanji City. An exploration of hypermedia applications for CALL. *CALICO Journal*, 6(4), 27-39.

Kanji City, a hypermedia program for teaching Japanese through trial-and-error exploration of a simulated real-life environment, is described. In addition, the possibilities for designing materials in hypermedia format and the advantages of Hypercard's potential for integrating text with synthesized sound, interactive graphics, and animation are explored.

Hall, W., & Others. (1989). Using hypercard and interactive video in education: An application in cell biology. *Educational and Training Technology International, 26*(3), 207-214.

This article describes the design and implementation of an interactive video system using existing videodiscs and Apple's Hypercard for use in the teaching of cell biology to undergraduate biology students. Hypertext and hypermedia are discussed, the hardware configuration is described, and a preliminary evaluation of the completed system is reported.

Hasselbring, T., Goin, T., & Wissick, C. (1989). Making knowledge meaningful: Applications of hypermedia. *Journal of Special Education Technology, X*(2), 61-72.

Hypermedia is discussed in relation to the "inert knowledge" problem that pervades much of the instruction in regular and special education. The historical roots of hypermedia are discussed as well as a theoretical rationale for why hypermedia can be a powerful tool for making knowledge meaningful. Finally, examples of prototype hypermedia environments for use with special-needs learners are presented.

Hofmeister, A. (1989). Teaching with videodiscs and teaching fractions with videodiscs and mainstreaming students with learning disabilities for videodisc math instruction. *Teaching Exceptional Children, 21*(3), 52-60.

An introduction to laser videodisc technology is presented, covering both hardware and courseware and technological applications to special education. The application of videodisc courseware to the teaching of fractions is described, and the results of a successful program to teach fractions to eight mainstreamed students with learning disabilities, using "Mastering Fractions" are presented.

Levinson, P. (1989). *Intelligent writing: The electronic liberation of text.* Paper presented at the annual meeting of the American Association for the Advancement of Science, San Francisco, CA. (ERIC Document Reproduction Service No. ED 309 768)

Levinson explores how books and their service structures in bookstores, libraries, and universities work to segment and isolate knowledge from some members of the population. In the context, electronic text and its capacity for instant transmissibility across large distances, infinite duplicability, permanent storage, interactivity, modifiability, and "hypertext" instant cross-referencing, are analyzed in three related environments for the new possibilities it holds for literacy: (1) word processing, (2) hypertext, and (3) hypermedia.

Tucker, S. A. (1989). Welcome to the hypercard corner. *TechTrends, 34*(2), 30-34.

This article describes applications of HyperCard, including SuperDuper Gradebook and HyperMedia Information Retrieval System (HIRS). Also described is the creation of an instructional software library called the HyperMedia and Instructional StackWare Clearinghouse (HISC), which will evaluate programs for educators, trainers, and instructional technologists.

Underwood, J. (1989). Hypermedia: Where we are and where we aren't. *CALICO Journal,* 6(4), 23-26.

This article explores current uses of HyperLang, a sophisticated hypermedia authoring system that understands spoken speech, in computer-assisted foreign language learning. Underwood suggests that software developers should adopt an educational and humanistic perspective in further developing this technology to ensure the creation of effective educational tools.

White, C. S. (1988). *Computers in social studies classrooms: ERIC digest EDO-SO88-5.* Bloomington, IN: ERIC. (ERIC Document Reproduction Service No. ED 296 950)

This ERIC Digest discusses three topics: (1) computer use in the classroom; (2) what is known about the effects of computer use on teaching and learning; and (3) trends likely to develop in the use of computers. Research results of computer use are presented in terms of the effects of drills and tutorials, simulations, and databases. Projected trends include these beliefs: there will be an increased development of interactive videos and access to data will increase through the use of modems, CD-ROM discs, and hypermedia systems.

APPLICATIONS, LANGUAGE ACQUISITION

Clymer, E. W. (1991). Using hypermedia to develop and deliver assessment or intervention services. *Topics in Language Disorders, 11*(2), 50-64.

Development of hypermedia and powerful computer systems have enabled speech-language clinicians to produce materials that can be used to assess or provide instruction in the use of language content and form. This article describes the features of hypermedia and the benefits of developing clinical applications based on a hypermedia format.

Nelson, K. E., Prinz, P. M., & Others. (in press). Processes for text and language acquisition in the context of microcomputer-videodisc instruction for deaf and multihandicapped children. In Martin, D. S. (Ed.) *Advances in Cognition*. Washington, DC: Gallaudet College Press.

This study examines reading and writing instruction through a highly interactive program for microcomputers. Key elements of the project include a modified keyboard that displays words rather than letters and a system involving exploratory learning. The results of the research suggest enhanced processing of text in ALPHA's CAI learner-controlled system through rapid activation of parallel channels of text, picture and sign meaning.

APPLICATIONS, LIBRARY

DeBuse, R. (1988). So that's a book...Advancing technology and the library. *Information Technology and Libraries,* 7(1), 7-18.

This article reviews key developments in information technologies and describes the possible convergence of these developments in the creation of a new publishing and communication medium. The impact of this technology on the organization and role of libraries is discussed.

Franklin, C. (1988). The hypermedia library. *Database, 11*(3), 43-48.

This article describes hypermedia, which allows the associative retrieval, manipulation, and storage of music, video, text, and graphics. Examples of applications are given; the use of hypermedia with interactive video and with microcomputers is discussed; and their implications for library and information specialists are explored.

Lancaster, F. W. (1989). Electronic publishing. *Library Trends, 37*(3), 316-325.

This article describes various stages involved in the applications of electronic media to the publishing industry. Highlights include computer typesetting, or photocomposition; machine-readable databases; the distribution of publications in electronic form; computer conferencing and electronic mail; collaborative authorship; hypertext; hypermedia publications; and future possibilities.

Triebwasser, M. A. (1988). *The electronic library: The student/scholar workstation, CD-ROM and hypertext.* Paper presented at the annual meeting of the American Political Science Association, Washington, DC. (ERIC Document Reproduction No. ED 307 896)

This paper discusses innovative computer technologies— particularly CD-ROM and Hypertext—and their roles in the electronic library. The major topics presented include: (1) the development of powerful microprocessors to provide analogue representation; (2) the new trend of information in databases; (3) hypertext and hypermedia; (4) the functional importance of the asymmetric technology of CD-ROMs; (5) storage needs of different types of information; (6) how machine readable text is stored on CD-ROM; (7) optical character recognition technologies (OCR); (8) advantages and disadvantages of electronic imaging; (9) technological impediments (OCR technology, high resolution monitors, fast networks); and (10) institutional impediments (copyright and economic considerations, lack of standards for CD- ROMs).

APPLICATIONS, ROBOTS

Center for Advanced Technology in Education. (1987). Extending the human mind: Computers in education. *Programs and Proceedings of the Annual Summer Computer Conference*. Eugene, OR: Oregon University. (ERIC Document Reproduction Service No. ED 290 433)

Presented in this proceedings document are 27 papers describing a variety of educational uses of computers. Three papers are of particular interest: "Empowering Environments, Hypermedia and Microworlds" (Christopher Dede), "Robots in the Elementary Curriculum" (Elizabeth Anne Viau), and "Using Robots to Teach Science" (Elizabeth Anne Viau).

Eisenstadt, M., & Brayshaw, M. (1990). A knowledge engineering toolkit. Part I. *Byte, 15*(10), 268-282.

In this first article of a two-part series, the authors define knowledge engineering shells and toolkits. The shells are described as ready-made solutions that allow developers to prototype expert systems quickly. Toolkits offer the flexibility of building hybrid, custom-designed expert systems. MIKE (Micro Interpreter for Knowledge Engineering) is a toolkit with four components: a top level, a working memory, a frame memory, and a rule memory. The article discusses how to implement the toolkit in a subset of Edinburgh-syntax Prolog so that it will run on standard PC compatibles.

Eisenstadt, M., & Brayshaw, M. (1990). A knowledge engineering toolkit. Part II. *Byte, 15*(12), 364-370.

In this second article of a two-part series, the authors continue the account of the implementation and use of a knowledge engineering toolkit entitled MIKE (Micro Interpreter for Knowledge Engineering). MIKE is part of a text/video package developed at the Human Cognition Research Lab at the Open University in England. It provides a fully commented sources code that illustrates how to implement a knowledge engineering environment from scratch.

Hofmeister, A., & Ferrara, J. (1986). Expert systems and special education. *Exceptional Children, 53*(3), 235-239.

The article discusses the characteristics of expert systems (computer programs designed to replicate human expertise in a variety of areas). Hofmeister describes recently available expert system development tools and suggests applications within the field of special education. Recent efforts to apply expert systems technology to special education problems are also reviewed.

Lippert, R. C. (1989). Expert systems: Tutors, tools, and tutees. *Journal of Computer-Based Instruction, 16*(1), 11-19.

This article discusses the current status, research, and practical implications of artificial intelligence and expert systems in education. Topics discussed include computer-assisted instruction, intelligent computer-as

sisted instruction, intelligent tutoring systems, instructional strategies involving the creation of knowledge bases, decision aids, computer-based training, knowledge clarification, and novice knowledge engineering.

Merrill, M. D. (1987). The new component design theory: Instruction design for courseware authoring. *Instructional Science, 16*, 19-34.

This paper outlines extensions of Component Display Theory (CDT) to provide the type of design guidance needed for experiential computer-based instructional systems. The new CDT extends the original theory in several significant ways. Content types are extended to content structures. These content structures include experiential as well as structural representations. Primary presentation forms are extended to primary presentation function and the display is replaced by the transaction. Various types of transactions are identified for both structural and experiential representations. Course organization is included as part of the new CDT. Intervention transaction selection and sequence, intercontent representation selection and sequence, and control are discussed.

Summers, E. (1990). ES: A public domain expert system. *Byte, 15*(10), 289-292.

Summers describes ES, a public domain expert system shell that is complete with samples that can assist in the development of an expert system. An expert system is defined as one that captures knowledge from human experts and is then used to diagnose problems or learn about a specific knowledge domain.

Underwood, J. (1989). On the edge: Intelligent CALL in the 1990s. *Computers and the Humanities, 23*(1), 71-84.

This article examines the possibilities of developing computer-assisted language learning (CALL) based on the best of modern technology, arguing that artificial intelligence (AI) strategies will radically improve the kinds of exercises that can be performed. Underwood recommends combining AI technology with other tools for delivering instruction, such as simulation and hypermedia.

Weyer, S. A. (1987). As we may learn. *Learning Tomorrow: Journal of the Apple Education Advisory Council, 3*, 89-109.

This paper considers the development of intelligent multimedia knowledge systems. Particular attention is focused on learner needs and intentions in information seeking, and the implications of these factors for the development of intelligent multimedia knowledge systems are considered. The paper concludes with a discussion of the possibility of creating hypermedia systems that go beyond the improvement of searching and browsing

techniques to create intelligent systems that might almost emulate expert human behavior.

Wiggs, C. L., & Perez, R. S. (1988). The use of knowledge acquisition in instructional design. *Computers in Human Behavior, 4*(3), 257-274.

Discussion of expert systems focuses on knowledge acquisition methodologies and their potential application to cognitive science research and the development of instructional materials. Topics discussed include subject matter experts, types of knowledge, structured interviews, task analysis, intelligent computer-assisted instruction (ICAI), knowledge mapping, and future research issues.

CD-ROM

Congress of the U. S. (1988). *Power on! New tools for teaching and learning.* (Report No. OTA-SET-379). Washington, DC: Office of Technology Assessment. (ERIC Document Reproduction Service No. ED 295 677). A summary of the study which also appears as the first chapter of this report, is also available as a separately bound publication: "Power on! New tools for teaching and learning, Summary." (OTA-SET-380).

This report examines developments in the use of computer-based technologies, analyzes key trends in hardware and software development, evaluates the capability of technology to improve learning, and explores ways to increase student access to technology. Specific topics addressed include the adoption of computer and video technologies, evaluation research, computer- assisted instruction (CAI) and intelligent CAI, mathematics and science, multimedia programs, database management, word processing,language arts, electronic networks, cost- effectiveness, software, and research and development. The future of classroom instruction is discussed in terms of networking and distance education, CD-ROM and computer/video convergence, hypermedia, integrated learning systems, and videodiscs.

Rowe, M. B., & McLeod, R. (1988). Science and math instruction: A new partnership. *Media and Methods, 25*(2), 13-16, 72-73.

Discussion of the use of new technologies in science instruction focuses on the medium of CD ROM. Topics discussed include database retrieval, simulations and laboratory experiments, videodiscs, hypertext, and software and interfaces for laboratory experiments. A list of math and science resources is provided.

Bereiter, C. (1991). Implications of connectionism for thinking about rules. *Educational Researcher, 20*(3), 10-16.

Through use of a concrete analogy, this articles attempts to provide a nontechnical explanation of what connectionism is like and to show how it constitutes a radical alternative to the classical view of cognition based on implicit rules. The "frisbee and rubber-band model" demonstrates learning a complex set of patterns without learning any rules, and it demonstrates what is means for knowledge to be "in the connections." The author proposes that the most important contribution of connectionist theory of education may lie in helping us to think more clearly about the role of rules as instruments and objects of instruction.

The Cognition and Technology Group at Vanderbilt. (1990). Anchored instruction and its relationship to situated cognition. *Educational Researcher, 19*(6), 2-10.

This paper discusses some of the research at Vanderbilt University on the effects of situating instruction in videodisc-based, problem-solving environments (anchored instruction). It relates ideas on anchored instruction to the concept of situated cognition. The paper is organized into three major sections: (a) theoretical and empirical background of anchored instruction, (b) discussion of two projects involving anchored instruction, and (c) discussion of relationships between anchored instruction and situated cognition.

Salomon, G., Perkins, D. N., & Globerson, T. (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher, 20*(3), 2-9.

The authors suggest that a difference exists between effects <lwith and effects *of* technology use. Effects *with* technology use concern the changes in performance that students display while equipped with a technology. Technology in this case is defined as an intelligent tool effecting what students do and how well they do it. The second class of effects refers to the effects *of* the technology on the students' general cognitive capacities. It is argued that effects both *with* and *of* technology depend on an individual's mindful engagement with the tool. The use of computers to extend cognitive abilities is briefly discussed within wider normative, theoretical, and practical contexts.

Steinberg, Ester. (1989). Cognition and learner control: A literature review. *Journal of Computer-Based Instruction, 16*(4), 117-121.

Studies of learner control in the last decade support earlier findings that students who have little prior knowledge about a subject are likely to perform poorly under learner control. For simple tasks there is little difference in performance between learner and computer control. Recent research focuses on the effect of students' learning processes on learner control, on learner control supported by adaptive advice, and on shifting locus of control from computer to student as learning progresses. Research findings pertaining to learner control in computer-assisted instruction are in agreement with non-CAI research.

CULTURAL/ETHICAL ISSUES

Bork, A. (1988). Ethical issues associated with the use of interactive technology in learning environments. *Journal of Research in Computing in Education, 21*(2), 121-128.

This article discusses general social, moral, and ethical issues connected with computers in education; considers ethical issues related to the development of computer-based learning materials; and examines the use of the computer as a medium for ethical and moral education. Highlights include equity of access, games and learning, and cultural bias.

Howell, R. (1988). The ethics of technological intervention with disabled learners. Symposium: *Technological equity: Issues in ethics and theory*. Proceedings of selected research papers presented at the annual meeting of the Association for Educational Communications and Technology, New Orleans, LA (ERIC Document Reproduction Service No. ED 295 624)

This paper considers how technology can and should be incorporated into the design of instructional systems for the use of learners who are disabled. The importance of the instructional designer being aware of the characteristics of the target population, including the psychomotor, cognitive, and affective factors involved is emphasized. A user-oriented instructional design process model first proposed by Burkman is presented along with suggested adaptations specific to the design for the learner who is disabled.

Martin, B. L. (1988). The ethics of equity in instructional design. Symposium: *Technological equity: Issues in ethics and theory.* Proceedings of selected research papers presented at the annual meeting of the Association for Educational Communications and Technology, New Orleans, LA (ERIC Document Reproduction Service No. ED 295 629)

This paper questions how much of the instructional process instructional designers should control by preplanning and managing instruction so that it is equitable. Three specific concerns are addressed: (1) whether the designer who plans the instruction or the student is responsible for student learning; (2) whether or not the contingencies of instruction can be managed to ensure student learning; and (3) how instructional design can encourage learner self-development and ensure that students take some responsibility for their own learning.

CURRENT MULTIMEDIA PROJECTS

The Cognition and Technology Group at Vanderbilt. (1990). Anchored instruction and its relationship to situated cognition. *Educational Researcher, 19*(6), 2-10.

Vanderbilt University is producing and testing a series of videodisc adventures designed to develop middle-school students' mathematical problem formulation and problem-solving abilities. Each adventure of "Jasper Woodbury" becomes an invitation to solve the challenging, real-life problem confronting one of the characters in the video. The mathematical data required to solve the problem is embedded in the video adventure. While the series is designed principally to foster mathematical problem solving, each adventure represents a contextualized learning environment containing links to other curriculum areas such as science, geography, and history.

Friedlander, L. (1986). The Shakespeare project. *Learning Tomorrow: Journal of the Apple Education Advisory Council.* 123-152.

The Shakespeare project, developed at Stanford University, was designed in order to provide undergraduate students with more enjoyable and effective drama and literature instruction. A set of videodiscs present interviews with actors from several versions of Hamlet, scenes from the play, and a broad array of costume and prop examples. The program encourages students to think about the process of translating a play's script into action on the stage and to consider prop and costume choice for miniature plays that students can create and animate on the Macintosh.

Nelson, T. H. (1987). *Literary machines*. Available from Project Xanadu, 8480 Fredericksburg, #138, San Antonio, TX 78229.

Ted Nelson, who coined the term "hypermedia," envisioned an electronic system by which linkages between pieces of information could be physically represented and stored for future reference. His Xanadu project is attempting to create a universal information utility that allows every person on the planet access to everything ever written. It is now being developed for commercial use by Autodesk, Inc., makers of AutoCAD.

Tyre, T. (1989). Live TV broadcasts from the ocean floor bring new depth to science education. *T.H.E. Journal,* 17(1), 42-46.

With corporate project sponsors and funding from the National Science Foundation, more than 250,000 students and teachers took part in the JASON project, in May, 1989. Using remotely operated underwater vehicles (ROVs), a British charter vessel named Star Hercules, special fiber-optic cables, and advanced satellite communications, the project linked students to researchers at sea. High-quality, color video telecasts were transmitted and received by students stationed at control rooms located within museums across the U.S. and Canada. Two-way audio links allowed students to ask questions of the researchers aboard the Star Hercules and hear the answers, all in real-time.

Wilson, K. S., & Tally, W. J. (1987). *The Palenque project: A process of design and development as research in the evolution of an optical disc prototype for children*. (Tech. Rep. No. 47.) New York: Bank Street College of Education. (ERIC Document Reproduction Service No. ED 319 391)

This report describes the Palenque project, a DVI prototype developed by the Center for Children and Technology in collaboration with the David Sarnoff Research Center. The project was intended to create a rich, multimedia database environment for children and their families that would pique their curiosity and foster self-guided exploration, information seeking, and decision making. The program is set in the rainforests of central Mexico, and demonstrates many DVI capabilities: surrogate travel, 360-degree panoramas under full user control, and a rich audio/video database called the Palenque "museum." The digitized video is completely in control of the viewer, who can take a simulated trek through the Palenque site and also access in-depth information about various themes.

HISTORICAL PERSPECTIVE

Chen, Cing-Chih. (1989). As we think: Thriving in the hyperweb environment. *Microcomputers for Information Management,* 6(2), 77-97.

This paper discusses the historical development of hypertext/hypermedia, recent advances in their application, and potential problems with this technology. A hypermedia research and development project (Project Emperor I) that experimented with several major delivery system platforms is described. The potential of this type of application for librarians, information professionals, and media specialists is explored.

Cluck, M. (1990). Hypermedia: Information done your way. *School Library Media Quarterly, 18*(4), 215-222.

The features, advantages, and disadvantages of current hypermedia systems, types of systems, development environments, desirable features, and library and media center applications are described in this paper. An annotated list of hypermedia products, a list of associations and services for further information, and historical notes on hypermedia development are also provided.

HYPERBASE

Chen, C., & Others. (1988). The new concept of HYPERBASE and its experimentation on the "First Emperor of China" videodisc. *Microcomputers for Information Management,* 5(4), 217-246.

This article describes the new concept of HYPERBASE and its relationship to classical hypermedia, a multimedia database retrieval system (SOPHIADOC) and its features in relation to the HYPERBASE concept, and an experimental use of SOPHIADOC to organize and scroll selected images on the "First Emperor of China" videodisc. Fifteen project publications and 12 references are listed.

Beck, J. R., & Spicer, D. Z. (1988). Hypermedia in academia. *Academic Computing, 2*(5), 22-25, 49-50.

This article briefly reviews the origins of the hypermedia concept, comments on its use in higher education, and describes a project at Dartmouth College that developed a training process to introduce a hypermedia authoring environment to the academic community.

Campbell, R. (1989). (I learned it) through the grapevine: Hypermedia at work in the classroom. *American Libraries, 20*(3), 200-202, 204-205.

This article describes a project that was intended to aid students researching "The Grapes of Wrath" and that resulted in a program that uses the Apple Macintosh computer with HyperCard and a videodisc to put users in touch with the sights, sounds, issues, and events of the United States in the 1930s.

Corcoran, E. (1989). Show and tell. *Scientific American, 261*(1), 72, 74.

Hypermedia systems incorporating computers, videodiscs, and monitors are described in this article. A discussion of classroom and industry applications is followed by a summary of criticism and issues involving hypermedia.

Coughline, J. M. (1989). *Recent developments in interactive and communicative CALL: Hypermedia and "intelligent" systems*. (ERIC Document Reproduction Service No. ED 313 909)

Two recent developments in computer-assisted language learning (CALL), interactive video systems, and "intelligent" games are discussed. Systems combining the use of a computer and video disc player, Compact Discs Interactive (CDI), and Digital Video Interactive (DVI) are reviewed. The introduction of artificial intelligence in the programming of CALL, allowing the user to communicate more freely with the machine within a given domain or microworld, is examined. Producers and addresses for CALL interactive videodisc system and videodisc authoring systems are listed.

Gaines, B. R., & Vickers, J. N. (1988). Design considerations for hypermedia systems. *Microcomputers for Information Management, 5*(1), 1-27.

This article reviews the background, concepts, and role of hypermedia systems and analyzes essential, expected, and desirable features of

hypermedia in order to provide a basis for system design and evaluation. Four hypermedium shells and systems are described and approaches to user interface problems are discussed.

Halasz, F. G. (1987). NoteCards: A multimedia idea processing environment. *Learning Tomorrow: Journal of the Apple Education Advisory Council, 3*, 111-117.

NoteCards is a computer environment designed to help people work with ideas. The basic framework of this hypermedia system is a semantic network of electronic notecards connected by arbitrarily typed links. Four basic constructs are included in the system: notecards, links, browsers, and fileboxes. Notecards contain an arbitrary amount of information embodied in text, graphics, images, voice, or any other editable or presentable substance. Links are used to represent binary connections or relationships between cards. Browsers are cards that contain editable note-link diagrams showing the structure of some portion of the network. Fileboxes are cards that provide the user with a hierarchical filing structure for organizing collections of cards into topics or categories.

Heller, R. S. (1990). The role of hypermedia in education: A look at the research issues. *Journal of Research on Computing in Education, 22*(4), 431-441.

Hypertext and its extension, hypermedia, are being used to create new forms of educational software: hypermedia-assisted instruction (HAI). In order to create classroom material that is both instructional and motivating, educators and designers must confront a variety of educational issues and problems endemic to hypermedia itself, as well as problems related to education in an unstructured environment. Using techniques usually associated with metastudies, this paper looks at the research in discovery and incidental learning as well as hypermedia environments in order to distill those findings that can inform the development of HAI. (Author)

Irish, P. M., & Trigg, R. H. (1989). Supporting collaboration in hypermedia: Issues and experiences. *Journal of the American Society for Information Science, 40*(3), 192-199.

This article discusses hypermedia as an appropriate medium for supporting collaborative work and describes hypermedia systems in general and NoteCards in particular. Experiences of collaborators working with NoteCards and the resulting development of two tools are described. The authors outline future developments for these tools and NoteCards.

Kahn, P. (1988). *Information retrieval as hypermedia: An outline of InterBrowse*. (ERIC Document Reproduction Service No. ED 298 968)

InterBrowse is a uniform interface information retrieval application for several different databases. It was developed in response to the need for an interface that could be used with the hundreds of collections of bibliographic and numeric data, reference collections, and collections of digital images that are currently available on the software market. The application is broken down into five steps: (1) a high-level browser; (2) a database-specific browser and query builder; (3) a set of tools for refining and reapplying queries; (4) a tool for using results to develop queries in other collections; and (5) a personal management information system. The linking structure of the hypermedia environment used here adds another layer of possible information management: saving links among pieces of information in a way that makes these links easy to navigate.

Marchionini, G. (1988). Hypermedia and learning: Freedom and chaos. *Educational Technology, 28*(11), 8-12.

This article describes hypermedia and its potential uses in learning and teaching. Highlights include storage and manipulation of information; levels of learner control, the roles of teachers and learners and the interactions between them, theoretical and technical problems, instructional difficulties, and evaluation principles of hypermedia.

Sculley, J. (1988). The relationship between business and higher education: A perspective on the twenty-first century. *EDUCOM Bulletin, 23*(1), 20-24.

Discussion of the effects of the new information age and new technologies on business and higher education was originally given as the keynote address at EDUCOM '87. Highlights include new organizational patterns, a new paradigm for lifelong learning, the necessity for integrating research and instruction, hypermedia, simulation, and artificial intelligence.

Stevens, G. H. (1989). Applying hypermedia for performance improvement. *Performance and Instruction, 28*(6), 42-50.

This article discusses the use of hypermedia for performance improvement interventions in light of traditional approaches to computer-based training (CBT). The following areas are explored: (a) problems with CBT; (b) hypermedia and hypertext; (c) links with data files; (d) hardware selection; and (e) comparison of hypermedia systems.

Trotter, A. (1989). Schools gear up for "hypermedia"—A quantum leap in electronic learning. *American School Board Journal, 176*(3), 35-37.

A new technological phenomenon known as "hypermedia" or "interactive multimedia" allows the learner to be in control and to access a variety of media with a computer. Advances in information storage technology have placed libraries of documents, sounds, and video and graphic images on laser discs.

Underwood, J. (1988). Language learning and "hypermedia." *ADFL Bulletin, 19*(3), 13-17.

This article describes the concept of hypermedia, by which readers select and link segments of text, audio, video, or other media in a way that helps them to explore and understand information. A case is made for the use of hypermedia in helping students learn and understand language through its provision of massive doses of comprehensible information.

Yankelovich, N. (1986). *Intermedia: A system for linking multimedia documents*. (IRIS Tech. Rep. No. 86-2). Providence, RI: Brown University. (ERIC Document Reproduction Service No. ED 296 735)

"Intermedia" is a hypermedia system which was developed for use in university research and training. It provides a framework for object-oriented, direct manipulation editors and applications, and the capability to link together materials created with those applications. Instructors are able to construct exploratory environments for their students as well as use applications for their day-to-day work, research, and writing. The paper focuses on several important user features and illustrates the operation of the system through a sample session.

Yankelovich, N., & Others. (1987). Issues in designing a hypermedia document system: The Intermedia case study. *Learning Tomorrow: Journal of the Apple Education Advisory Council, 3*, 35-87.

Intermedia, a hypermedia system, is first described and then used as a case study to explore a number of key issues that software designers must consider in the development of hypermedia document systems. A hypermedia document system is defined as a system that provides a set of tools that allow authors to share a network of linked documents, link their own and others' documents together, leave notes for one another, and retrieve information stored in documents of different types. The major issues addressed include various design options for linking together multimedia documents, the contexts in which those links exist, and the need for visual representation of the links that exist within a given context.

Baird, P. (1988). HyperCard opens an electronic window on Glasgow. *Electronic Library,* 6(5), 344-353.

This article reviews the theory, background, and general applications of hypertext and describes the design of Glasgow Online, an integrated database of information on the life and times of the city. Problems with the design of an interface for non-expert users and possible models for structuring information and establishing links are discussed.

Boone, R., & Higgins, K. (1990). *Year 2 monograph hypertext and hypermedia: Applications for educational use.* Seattle, WA: Experimental Education Unit, University of Washington.

The document is organized in three sections: (1) a discussion of the terms hypertext, hypermedia and HyperCard; (2) an article with instructions for creating a simple hypertext document template and subsequent hypertext lessons, using Macintosh's HyperCard software; and (3) a report presenting the results of two studies designed to explore the use of hypertext CAI study guides. The results and conclusions drawn from the two studies indicate the the hypertext study guides could be effective as a substitute for teacher-led instruction, as a supplement to teacher-led instruction, and as added instruction for lower- achieving students.

Higgins, K., & Boone, R. (1989). *Year 1 monograph hypertext CAI: Maintaining handicapped students in a regular classroom reading program.* Seattle, WA: Experimental Education Unit, University of Washington.

This monograph contains two sections: Part 1, Hypertext: A new vehicle for computer use in reading instruction; and Part 2, Hypermedia CAI: A supplement to an elementary school basal reading program. Part 1 provides an overview of both hypermedia and hypertext. In addition, the development of hypertext CAI based on basal readers is discussed in terms of three levels of instructional features: (1) text with enhanced surface structures; (b) text with enhanced syntactic and semantic structures, and (c) text with built-in comprehension strategies. Part 2 includes results of a study designed to examine the effects of hypermedia CAI reading lessons on mainstreamed and at-risk students. Findings support the use of hypermedia CAI reading material as a supplement to teacher directed instruction.

Jonassen, D. H. (1988). Designing structured hypertext and structuring access to hypertext. *Educational Technology, 28*(11), 13-16.

This article reviews conceptual bases for hypertext, relates them to hypertext design issues, and suggests research issues that need to be addressed. Topics discussed include cognitive psychology, schema theory and semantic networks, problems with hypertext, knowledge structures, software, inductive and deductive design methods, and expert systems.

Kearsley, G. (1988). Authoring considerations for hypertext. *Educational Technology, 28*(11), 21-24.

This article discusses some of the major aspects of authoring hypertext documents and databases as forms of interactive instruction. Highlights include knowledge structuring, root document, authoring tools, screen formats, computer graphics, collaboration among authors, cognitive processes, and degree of learner control.

Kinnell, S. K., & Richards, T. (1989). An online interface within a hypertext system: Project Jefferson's electronic notebook. *Online, 13*(4), 33-38.

This article describes an online system originally designed to assist freshman writers develop research skills. The system incorporates a desktop approach to information management, using Apple Computer's HyperCard, in which students have access to a dynamic notebook and linked reference materials. Online searching in a hypertext environment is described.

McKnight, C., & Others. (1988). The construction of hypertext documents and databases. *Electronic Library,* 6(5), 338- 342.

McKnight argues that access to hypertext documents in read-only forms contradicts the assumption that hypertext removes the distinction between author and reader. The implications for authors of hypertext documents are discussed. Creation of hypertext versions of journal articles and a database of such articles are described.

Paz, N., & Others. (1989). Using graphical study trees to present HELP knowledge. *Microcomputers for Information Management, 6*(1), 47-67.

This article discusses methods for the retrieval of help knowledge items using graphical tree structures that conform to the hierarchical nature of the tutorial information being referenced. The implementation of "Study Tree Presenter," a special purpose "hypertext shell" that provides such access is described, and several samples of screen displays are provided.

Pennsylvania State University. (1988). *Adult literacy and technology national conference*, Cupertino, CA: Gannett Foundation; Rochester, NY: Office of Vocational and Adult Education; Washington, DC: Division of Adult Education. (ERIC Document Reproduction Service No. ED 298 291)

Proceedings of a conference designed to teach about new techniques and methodologies for applying technology as a solution to adult illiteracy are presented. Representative topics include using hypermedia in adult literacy programs, teaching reading with a computer, using telecommunications to provide literacy training, interactive video disc and workplace literacy training, and microcomputers in the adult learning environment.

Smith, K. E., & Others. (1988). *Hypertext and information retrieval. Online, 12*(2), 32-40, 42-46.

An overview of hypertext and hypermedia is followed by a description of the Intermedia system. Possibilities for using hypertext in the information industry are explored. A sidebar discusses information retrieval in the humanities using hypertext, and a 58-item annotated bibliography on hypertext is presented.

INSTRUCTIONAL DESIGN

Allred, K. F., & Locatis, C. (1988). Research, instructional design, and new technology. *Journal of Instructional Development, 11*(1), 2-5.

This article examines three instructional designs involving new interactive media: scenario-based, hypermedia, and parallel system designs. Hypotheses about their learning effects are advanced, based on findings in three areas of research: intrinsic motivation, aptitude for learning, and learner control of instruction.

Briggs, L. J. (Ed.). (1991). *Instructional design: Principles and applications* (2nd ed.). Englewood Cliffs, NJ: Educational Technology Publications.

The book is intended as a text for developers of effective and efficient instruction, based upon a systematic and consistent theoretical framework. Part 1 contains the basic theoretical and procedural model. Needs assessment, goal analysis, and development of appropriate instructional and evaluation strategies are addressed. Part 2 presents a discussion of how the design is modified to adjust to features of organizations and institutions in which instruction takes place.

Gagne, R. M., & Briggs, L. J. (1979). *Principles of instructional design* (2nd ed.). New York: Holt, Rinehart & Winston.

Gagne's approach to instructional design reflects the belief that these efforts must meet standards of quality based on scientific research and theory in the field of human learning. The designer who follows the principles described in the text is assured that the details of instruction will have a sound foundation in research and theory.

Gagne, R. M. (1985). *The conditions of learning* (4th ed.). New York: Holt, Rinehart & Winston.

This classic text describes in a comprehensive manner how the findings of learning research and the ideas of cognitive learning theory can be used to indicate the conditions for effective learning and serve as a basis for instructional theory and design of instruction.

Iuppa, N., & Anderson, K. (1988). *Advanced interactive video design: New techniques and applications*. Falls Church, VA: Future Systems, Inc.

This volume (from the author of *A Practical Guide to Interactive Video Design*) reviews the latest applications of interactive videodisc technology. The book delineates design principals and how-to technique and explains the steps to developing a videodisc control program. The most promising applications of interactive video in computer training, education, entertainment, data storage, information, and point-of-sales are discussed.

Locatis, C. (1987). Instructional design and new technologies. *New Directions for Continuing Education, 34*, 89-100.

Instructional design for distance education is the focus of this paper. Common dimensions of distance education programs and technological advancements are explored. Locatis presents three possible instructional design: (1) scenario-based instruction, (2) hypermedia, and (3) parallel systems.

Louie, S., & Rubeck, R. F. (1989). Hypertext publishing and the revitalization of knowledge. *Academic Computing, 3*(9), 20- 23, 30-31.

This article discusses the use of hypertext for publishing and other document control activities in higher education. Topics discussed include a model of hypertext, called GUIDE, that is used at the University of Arizona Medical School; the increase in the number of scholarly publications; courseware development by faculty; and artificial intelligence.

Morrison, G. R., Ross, S., & Others. (1989). Learner preferences for varying screen densities using realistic stimulus materials with single and multiple design. *Educational Technology Research and Development, 37*(3), 53-60.

The purpose of this study was to operationalize and precisely define the construct of screen density, something that had been lacking in previous research. The researchers expected that when content was fixed and realistic, participants would not prefer the lower-density screens to the extent reported by previous research in instructional design. Participants preferred screen designs of medium or high density, as opposed to low density, when materials presented realistic information. This finding suggests that the amount of contextual support needed to learn is more important than aesthetic properties of screen design.

Rezabek, R., & Ragan, T. (1989, February). *Elaborated resources: An instructional design strategy for hypermedia*. Paper presented at the annual meeting for the Association for Educational Communications and Technology, Dallas, TX. (ERIC Document Reproduction Service No. #ED 316 175)

The elaborated resources theory provides an approach to the problem of balancing instruction and exploration within hypermedia environments. Based upon the linking capabilities of hypermedia, the theory is an attempt to extend computer-based instruction beyond the tutorial approach by integrating information retrieval capacities into the hypermedia environment. It facilitates the design of hypermedia environments that can serve as tutor, tool, and tutee, enhancing both instruction and learner exploration. Diagrams illustrating the elaborated resources theory are provided.

Romiszowski, A. J. (1981). *Designing instructional systems*. East Brunswick, NJ: Nichols Publishing.

This book emphasizes a systems approach to macro-level instructional design. In the opening chapters a five-stage general procedure for problem solving is outlined. To assist the decision-making process, a number of concept maps or schemata are presented in the appropriate chapters. The functions of the curriculum or course designer is analyzed in depth.

Romiszowski. A. J. (1984). *Producing instructional systems*. East Brunswick, NJ: Nichols Publishing.

The first of two books that deals with practical techniques for instructional development, examines the decisions that face an instructional designer when he or she is developing detailed lesson plans and selecting instruc-

tional materials. Romiszowski explores the process of task selection for explaining, demonstrating, illustrating, practicing, and evaluating the subject matter content to be mastered.

Romiszowski, A. J. (1986). *Developing auto-instructional materials*. East Brunswick, NJ: Nichols Publishing.

This second volume on instructional development examines the specialist skills involved in the design and development of individualized instructional materials. It deals specifically with automated instructional systems. Part 1 considers the concept of individualization and the role of mediated auto-instruction. Parts 2, 3, and 4 deal with three categories of auto-instructional materials development including: (a) print-based auto-instructional packages; (b) computer-based auto-instructional packages; and (c) audio-visual packages. Part 5 presents a general model for the development and field-testing of instructional materials.

INTERACTIVE VIDEO

Dalton, D. W. (1986). How effective is interactive video in improving performance and attitude? *Educational Technology, 26*(1), 27-29.

This study compared the effects of interactive video instruction on learner performance and attitude with conventional, CAI, and stand-alone video, in order to determine what types of tasks best lend themselves to interactive video instruction. The findings of the study indicate that CAI was the most appropriate medium for the identified learning task but interactive video produced significant improvements in both learner performance and learner attitudes. Dalton notes that although CAI might be appropriate for certain learning tasks care must be taken to avoid isolating low ability students.

Pavlonnis, T. (1988). Interactive video—A spellbinding approach to solid learning. *Media and Methods, 24*(5), 21-22, 24, 27.

This article describes the use of interactive video in secondary public schools in Great Falls, Montana. The need for visual learning; steps for integrating new technology into the curriculum, including planning, coordinating, teacher training, and evaluation; and the use of laserdisc systems for student-produced term papers are included.

Wissick, C. A., & Kinzie, M. B. (1989). The development and design of a videodisc simulation for training grocery shopping skills to students with moderate or severe handicaps. In R. Fox (ed.), *Proceedings from the Eleventh Annual Society for Applied Learning Technology Conference on Interactive Videodisc in Education and Training*, (pp. 28-31). Warrenton, VA: Society of Applied Learning Technology.

The introduction of new technologies such as the microcomputer and videodisc offer possibilities of increasing the effectiveness of special education training programs. The creation of simulations can model the experience of the natural environment and avoid the practical problems associated with training students in the community.

MULTIMEDIA

Ambron, S., & Hooper, K. (1990). *Learning with interactive multimedia: Developing and using multimedia tools in education*. Falls Church, Va: Microsoft Press, Future Systems, Inc.

This collection of 20 articles compiled by Apple Computer, Inc., explores the wide-ranging innovation of multimedia. The book is an account of real-world experiences in developing multimedia technology and integrating that technology into curricula.

McCarthy, R. (1989). Multimedia: What the excitement's all about. *Electronic Learning, 8*(8), 26-31.

Discussion of the use of multimedia for instruction in elementary and secondary school classrooms focuses on computer-controlled multimedia. Topics discussed include developmental software such as LinkWay and HyperCard; multimedia vendors; new configurations for term papers; the degree of learner control and activity; and the impact on learning.

Nicol, A., & Others. (1987). Multimedia in education: Thought pieces. *Learning Tomorrow: Journal of the Apple Education Advisory Council, 3*, 324-353.

The six "thought pieces" presented in this document summarize the personal perspectives of conference participants on issues raised in formal and information discussions. Highlights include: "A Layered Theory of Design for Optical Disc Software" (Mike Liebhold, Apple Computer, Inc.); "Links or Stories: A Compromise" (Bernard Frischer, University of California at Los Angeles); "Authoring with Hypermedia" (Carol Kaehler, Apple Com-

puter, Inc.); and "Navigation in Large Knowledge Spaces" (Steven Weyer, Apple Computer, Inc.).

Ropiequet, S. (1987). The microsoft multimedia encyclopedia. *Learning Tomorrow: Journal of the Apple Education Advisory Council, 3*, 303-320.

A multimedia encyclopedia (MME) demonstration disk has been developed by the Microsoft Corporation, which contains five-page articles on 12 subjects. Each article contains text, images, audio, and in some cases, animation and full motion digital images. Each MME article is constructed as a network of linked text, image, and sound files. With mouse or keyboard control, the user can browse through an article, select audio descriptions or sound effects, images, cross-references to other articles, or supplementary text information, and a mouse click activates the playback and display routines. The MME provides an alphabetically ordered index. By providing links to multiple levels of information using different media, this hypermedia system is able to accommodate a much broader audience than a static two-dimensional information system.

OVERVIEW

Ambron, S., & Hooper, K. (Eds.). (1986). Multimedia in education. Proceedings of an invitational conference on multimedia in education. *Learning Tomorrow: Journal of the Apple Education Advisory Council, 3*, 346. (ERIC Document Reproduction Document No. ED 302 179)

This collection of articles exploring multimedia in education was compiled from presentations at an invitational conference on multimedia in education. Following an introduction by Sueann Ambron ("New Visions of Reality: Multimedia and Education"), the articles are grouped under six headings: (1) computer science and engineering, (2) education, (3) television, (4) publishers, (5) images and interactivity, and (6) thought pieces. The text is supplemented by figures and illustrations, and some of the articles include references.

Dede, C. J. (1987). Empowering environments, hypermedia and microworlds. *Computing Teacher, 15*(3), 20-24, 61.

This discussion of advances in computers and information technologies focuses on the development and design of new educational software called cognition enhancers, which include empowering environments, hypermedia, and microworlds. The implications of this new technology for students and teachers and its impact on society are reviewed.

Forrest, C. (1988). Technological convergence: A brief review of some of the developments in the integrated storage and retrieval of text, data, sound and image. *TechTrends, 33*(6), 8-12.

This article reviews technological developments centered around microcomputers that have led to the design of integrated workstations. Topics discussed include methods of information storage, information retrieval, telecommunications networks, word processing, data management, graphics, interactive video, sound, interfaces, artificial intelligence, hypermedia, electronic publishing, cost factors, gender gap, and computer anxiety.

Helsel, S. K. (1991). *Interactive optical technologies in education and training: Markets and trends*. Westport, CT: Meckler Corp.

All interactive optical formats—interactive videodisc, CD-ROM, CD-ROM/XA, CD-1, and DVI—are analyzed and compared in this book. The first section includes educational applications of interactive optical media, a description of the training and education markets, and a discussion on multioptical design issues. The second section analyzes the trends that will affect future usage of interactive optical media in education and training markets.

Kinzie, M. B., & Berdel, R. L. (1990). Design and use of hypermedia systems. *Educational Technology Research and Development, 38*(3), 61-68.

A theoretical and research-based foundation is summarized that suggests answers to questions involving learner control, self- regulating learning, and continuing motivation. Recommendations are offered for the effective design of hypermedia systems and the appropriate preparation of learners who will use them.

Paske, R. (1990). Hypermedia: A brief history and progress report. *T.H.E. Journal, 18*(1), 53-56.

The first article in a three-part series designed to provide both a foundation in some of the technical aspects of hypermedia as well as an overview of where the concept comes from and where it is headed. Part 1 provides a history of hypermedia, briefly examines technologies such as the Integrated Services Digital Network (ISDN), and mentions technologies that will be delivering hypermedia to desktop computers in the future.

Paske, R. (1990). Hypermedia: A progress report/Part 2: Interactive videodisc. *T.H.E. Journal, 18*(2), 90-94.

This is the second installment in a three-part series. Part 2 examines the Level-III interactive videodisc. The article decodes a number of acronyms

and the technical details of videodisc formatting they represent. In addition, newly released software is reviewed.

Paske, R. (1990). Hypermedia: A progress report/Part 3: CD-ROM, CD-I, DVI, Etc. *T.H.E. Journal, 18*(3), 93-97.

This is the final article of a three-part series examining hypermedia. The following digitally encoded, optically read CD formats are reviewed: CD-ROM, CD-I, DVI, CDTV, and CD-ROM XA.

TRAINING

Council for Exceptional Children. (1989). *Project RETOOL: Training in advanced technology applications for postdoctoral leadership personnel. Special projects. Final report*. Reston, VA: Council for Exceptional Children. (ERIC Document Reproduction Service No. ED 313 888)

Project RETOOL's goal was to provide a quality training program in special education technology for teacher educators. The training was designed for higher education faculty who had mastered the basics of microcomputer operations and applications in special education. Training materials focuses on "AppleWorks," "Electric Desk," authoring systems, telecommunications applications, expert systems, hypermedia, interactive videodiscs, and adaptive and assistive devices.

DeBloois, M. L. (1988). *Use and effectiveness of interactive videodisc training: A status report*. Falls Church, VA: Future Systems, Inc.

Thirty studies by corporate, government, military, and educational users (conducted over the period 1980-1987) were examined, where videodisc technology was tested against other training methods. The report includes comprehensive charts and diagrams to illustrate the various effectiveness study results and conclusions.

VIDEODISCS

Hasselbring, T., & Others. (1987). An evaluation of a level-one instructional videodisc program. *Educational Technology Systems, 16*(2), 151-169.

In this project, a level one videodisc program entitled "Mastering Fractions" was evaluated. The evaluation was conducted in two parts. Part 1 was a

controlled study that compared the "Mastering Fractions" program to more traditional fractions curriculum while controlling for any novelty effect of the videodisc medium. Part 2 of the evaluation was a descriptive study that examined the use of "Mastering Fractions" in non-experimentally controlled classroom environments. Results of the evaluation indicated that use of this program resulted in significant skill gains and that these gains were due to the instructional content of the program.

Hofmeister, A., & Others. (1986). Videodisc technology: Providing instructional alternatives. *Journal of Special Education Technology, 7*(3), 35-41.

Five different levels of instructional videodisc and microcomputer configurations are described and discussed in reaction to the needs and resources of the special education program. The authors suggest that principles of effective instruction should be applied to the development and utilization of videodisc technology.

Schwartz, E. (1990). Videodiscs in education: Are schools being left behind? *Instructional Delivery Systems, 4*(1), 26-29.

Schwartz argues that schools are already 11 years behind in the videodisc field. This article addresses two key obstacles to implementing this technology in the schools: the poor network of good information and budget constraints. A comprehensive resource section provides information on books, educational videodisc directories, newsletters, and organizations. In addition, a simple interactive system that can be developed by educators is described.

Tarrant, M. R., Kelly, L. E., & Walkley, J. (1988). Project management guidelines to instructional videodisc production. *Educational Technology, 28*(1), 7-18.

This article describes the planning process for an interactive videodisc module in motor skills assessment and, more specifically, the formulation of a documented template to guide project managers and instructional technologists through the maze of organizational tasks involved in similar productions. The author's intention is to provide resources for design activities and highlight resources that were particularly helpful to them.

Thorkildesen, R., Fodor-Davis, J., & Morgan, D. (1989). Evaluation of a videodisc-based social skills training program. *Journal of Special Education Technology, X*(2), 86-98.

This study was designed to determine the effectiveness of a videodisc-based social skills training program for elementary school children with mild disabilities. The program teaches children how to use appropriate phrasing,

intonation, and body language in such social interactions as getting involved and being positive. The videodisc is used to present examples of appropriate and inappropriate social behaviors, and models to imitate in subsequent role-playing activities. Results of the study indicate that both videodisc instruction and upper tutoring were important to the success of the program. Videodisc program design considerations are also discussed. The program described is currently under development for conversion to a level one videodisc application, which will be available October, 1991.

Young, M., Vye, N., & Others. (1990, April). *Research on videodisc macrocontexts to enhance problem solving instruction for middle school students*. Paper presented at the annual meeting of the American Educational Research Association, Nashville, TN.

The paper reports the results of three research studies on the Jasper series of videodiscs under development at Vanderbilt's Learning Technology Center. Each Jasper adventure is embedded with mathematical data used to solve a challenging, real-life problem. The series is designed principally to foster mathematical problem-solving ability. Study 1 was undertaken to determine how middle-school students should perform on the Jasper 1 problem without instruction. Study 2 considered the effects of 5 days of problem-solving instruction in the Jasper videodisc context as compared to a control group receiving traditional computation and problem-solving instruction. Study 3 was undertaken to determine the baseline performance level of college students on the transfer task used in Study 2. The results of these studies target four problem-solving processes as the essential components of instruction using the Jasper videodisc: planning, problem formulating, goal-directed search, and experiencing complexity.

VIRTUAL REALITY

Bailey, C. W., Jr. (1990). Intelligent multimedia computer systems: Emerging information resources in the network environment. *Library Hi Tech, 8*(1), 29-41.

This paper surveys four possible types of multimedia computer systems: hypermedia, multimedia database, multimedia message, and virtual reality systems. The potential use of multimedia computer systems as public access systems in libraries is discussed, including fiscal, legal, organizational, standardization, and technological challenges that would have to be met.